on the opposite side; and it is remarkable that the coal on the upthrow side of the fault contains the less quantity.

In respect to the diversity that exists in the bituminous qualities of the coal from different parts of the South Welsh coal basin, it is well known that the non-bituminous, or stone coal, is found on the north side and at the west end; the bituminous coal on the south side and east end; and there is an intermediate region occupied by an intermediate quality.

Mr. Logan has lately ascertained that, in two or more of the principal collieries on the south side of the basin, near Swansea and Llansamlet, though the lower seams of coal carry their bitumen to points deeper in the earth than the higher ones, they begin to part with it at points further to the south. And it appears to him that these facts taken together, unless contradicted by further evidence, indicate the possibility of a rule in the change of quality; namely, that it occurs in parallel planes, cutting the seams of coal without regard to their strike or inclination, and dipping to the south or east of south.

There are two anticlinal lines, one running from Pont ar Dawe by Mynydd golli wartad and Llangafillach to Rhyd y mardi; the other from Loughor along the road towards Swansea, and then through the colliery of Sir John Morris at Pentre.

In the mountain limestone, on the south side of the basin, and to the east of Cefn bryn, there are two geological waves or edges running east and west.

The millstone grit appears above the mountain limestone, along the northern line of the basin; and it is also seen, but not so distinctly, on the southern side in Gower, and in the fractures of the rock which there represents it in Cel ifor Hill, near Llawhedian, and a few miles eastward wavellite is found in abundance.

On the Tidal Capacity of the Mersey Estuary—the Proportion of Silt held in solution during the Flood and Ebb circulations—the Excess of Deposit upon each Reflux, and the consequent Effect produced by the Matter thus detected in its transit, and measured at its lodgement, on the banks in Liverpool Bay; with Diagrams. By Captain DENHAM, *R.N.*

Captain Denham states the area of the Mersey, from Rock to Warrington, to be 113,171,200 square yards, and its average channel capacity 535,914,040 cubic yards, that mass of water circulating to and fro four times every 24 hours. The flood occupies $5^h 20'$. The velocity on the Narrows (from Seacombe to Prince's Terrace) is from 1 to $6\frac{3}{4}$ miles per hour, amounting to a transit of $23\frac{1}{4}$ on flood; the ebb is for $6^h 30'$, velocity $\frac{3}{4}$ to 7 miles per hour, and the amount of transit $29\frac{1}{4}$ miles. The greatest velocity on the flow is at the third hour; on the ebb, at the second: the impetus on the flow greater after the third hour than before; on the ebb, greatest on the first half ebb.

The insoluble matter held in suspension by the columns of flood and ebb amounts to 29 cubic inches for each cubic yard of water on the flood, and 33 cubic inches on the ebb,—the matter on the ebb exceeding that on the flood; so that 48,065 cubic yards of silt are detained by the banks outside the Rock Narrows each tide, except that part which the succeeding ebb disturbs.

The excess of silt thus accumulated from the 730 refluxes of a year's tides, amounts to 35,087,450 cubic yards, equivalent to a layer of mud, if equally disseminated, 21 inches thick over the first tidal area; one-third, however, of this is disturbed and carried over the second tide area; and, further, the deposit is lessened by the natural shrinking as it is consolidated (namely, into half its original bulk). The annual tangible deposit is therefore 11,695,817 cubic yards, which, equally disseminated, would produce a uniform increase of the banks, and decrease of water, in the Channel, of 7 inches. The subsidence, however, is not in equal proportions, but is directed towards certain knolls, margins of banks, and elongated spits, which protrusions cause scouring and choakings of particular channel-beds. Captain Denham further pointed out instances of the rapid filling up of certain channels, as well as the changes due to sudden change of circumstances, and the importance of preserving the present conditions of the harbour, inasmuch as regards the continuance of the present back-water in its full amount. The cross-set of the Irish Channel limits the extension outwards of the shoals; but notwithstanding this fortunate natural safety-valve, any neglect of those regulations which tend to check encroachments on the Channel, would so far facilitate the natural tendency to fill up, that in a very short period the part might be closed. Captain Denham pointed out the advantages of the new channel as compared with the old. That channel was discovered by himself, and is in itself an illustration of the resulting effects of the modification of the contour of the general tidal channel, and of the benefit to be derived from closely watching the operations, whether natural or artificial, by which it may in any way be altered.

In 1836, the new channel admitted 8208 vessels, 4077 of which could not without it have got in or out under four hours' delay upon each tide. In April 1837, 1571 vessels passed, 760 of which could not have passed any other way. The post-office packets have passed directly to and fro, with thirty-five exceptions, which exceptions, in 1832, amounted to 261, involving the necessity of transferring the mail and passengers by tender or boat. And, further, out of 29000 vessels that entered the port in the last two years, only nineteen had experienced serious difficulties.

Having thus shown the surplus quantity of mud which is at each tide deposited and added to the banks,—the natural tendency resulting from this accumulation to fill up the channel,—the fortunate existence, under the influence of the present conditions of the tidal or water-way, of a good and available channel, and the paramount necessity of securing the existence of that channel by allowing no such alteration in the boundaries of the water-way as should, by lessening the back-water, diminish the scouring of the reflux tide, or, by altering the form of the river-shores, tend to throw the current into new directions, and to stop up the existing channels; Captain Denham strongly urged the propriety of a power, vested in local guardians, to interfere whenever attempts should be made to encroach by embankments, or in any other way, on the present high-water-marks, as, in the present state of the law, a vital injury might be done to the port before an injunction could be obtained to restrain such dangerous operations. Captain Denham then explained and exhibited the simple gauge by which he had drawn up the water from various depths, to test the quantity of earthy matter suspended in it, and thus to measure at once simply and effectually, the aggregate quantity silently and almost imperceptibly circulating with the waters of this great estuary, and to deduce, with certainty, the practical as well as geological results of a continuance of the action of such natural causes under their present circumstances, and of the probable effect of any artificial modification of them. This instrument is a cylinder, seventeen inches long, and four in diameter, having a valve at each end, the lower opening inwards, the upper outwards; so that on descending, both valves would be opened by the pressure of the water, which would flow freely through the cylinder, and, on ascending, both valves would be closed, and the water which had entered at the lowest point of its descent, retained within it. The samples of water were taken up at half-hour intervals during the whole of the flood and ebb, and at depths in each series from six feet to thirty. The waters were more turbid at two hours' flood, and at two, three, four hours' ebb, and the water at thirty feet depth contained $\frac{1}{10}$ more of silt than at other depths. Thirty feet being the height of the spring-tide column, that was the maximum depth gauged.

On the Changes which have taken place in the Levels of Scotland.

By Mr. J. Smith.

Mr. Smith stated that there was abundance of evidence that changes had taken place in the relative levels of land and sea in Great Britain, as well as elsewhere. The phænomena, however, proving this fact had been involved in confusion under the title of diluvium; but he had full reason, from a careful examination of the fossils, to decide that much of these deposits belonged to the tertiary series, and not to the more recent deposits called diluvium. He had traced them in the county of Ayr, and indeed all round Scotland, the general height being 40 feet, though Mr. Gilbertson had stated an instance in which such a deposit had been found at 300 feet; from its generality, however, he considered 40 feet to have been the height of a distinct ridge or deposit. Finely laminated clay is a principal member of this deposit, and from the proportion of extinct and recent species, in the whole 113 species of shells, which he had discovered, he considered the deposit to agree with the Newer Pleiocene of Messrs. Lyell and Deshayes.